

Nuclear Databases for Reactor Applications

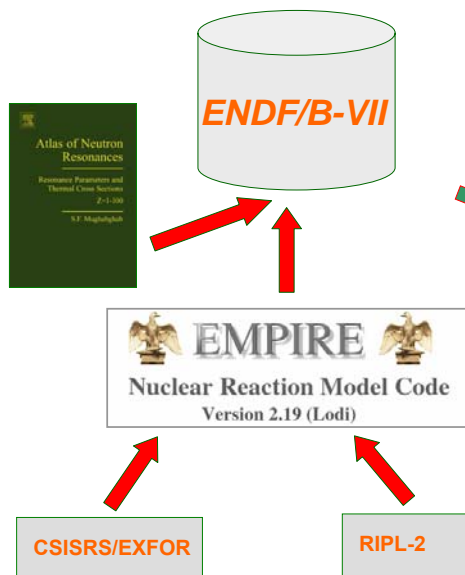
ENDF/B-VII Evaluations by NNDC



Neutron Sublibrary

Tools:

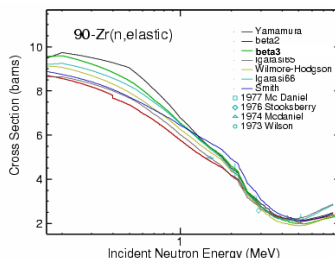
- Atlas of Neutron Resonances
- Empire 2.19 (nuclear reaction code)
- RIPL-2 (model parameters)
- CSISRS/EXFOR (experimental data)



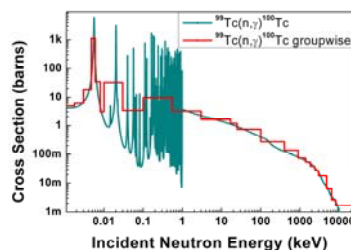
Results:

- 74 full evaluations
- 74 resonance evaluations
- 4 full, 8 fast covariances

Fast response to users' request:
Integral experiments call for higher elastic cross sections on Zr.



$^{99}\text{Tc}(n,\gamma)$ reaction for waste transmutation

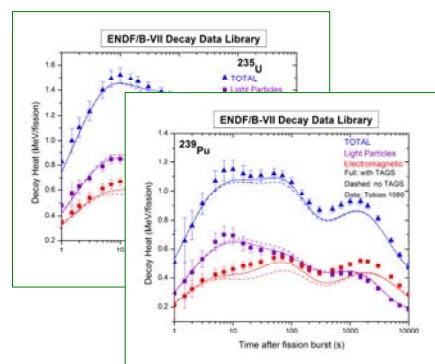


Decay Sublibrary

Main Sources:

- Evaluated Nuclear Structure Data File
- Nuclear Wallet Cards 2005
- TAGS data for fission products
- Covers all nuclides from Z=0 to Z=111
- 3830 materials in total

The total decay heat is separated in two components: electromagnetic and light particles. A heavy particle component, including neutrons and alphas is negligible.

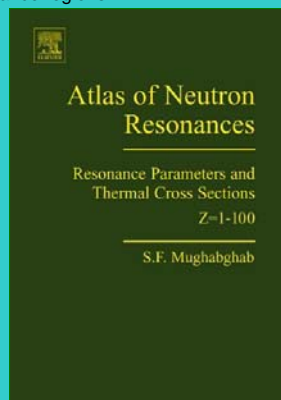


Atlas of Neutron Resonances

S.F. Mughabghab

Published by Elsevier in April of 2006

- The fifth edition of BNL-325
- Principal input of low energy (resonance region) data for ENDF/B-VII data library
- Individual resonance parameters and thermal cross sections for Z = 1-100
- Evaluated 98 elements, 476 isotopes, 381 resonance regions

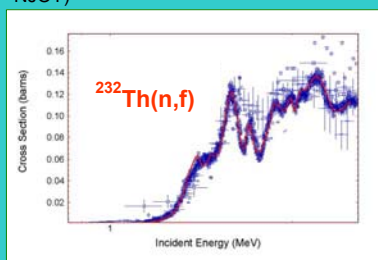


EMPIRE 2.19

(www.nndc.bnl.gov/empire)

Modular system of nuclear reaction codes for comprehensive modeling of nuclear reactions extensively used to produce evaluated nuclear reaction data for ENDF/B-VII.

- number of script-linked FORTRAN codes operated through GUI
- input parameter libraries
- experimental data library
- ENDF-6 formatting
- Data verification (checking codes, plotting, NJOY)



Reaction models:

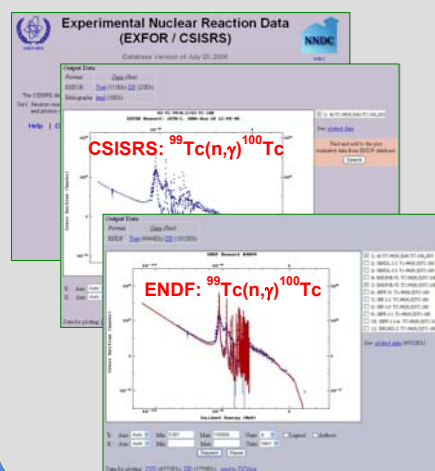
- Coupled Channels and optical model
- Full featured Hauser-Feshbach
- Various preequilibrium models
- Multi-modal fission with under-barrier transitions

Experimental Data CSISRS/EXFOR

(www.nndc.bnl.gov/exfor)

Principal source of experimental nuclear reaction data for ENDF evaluations.

- Incident neutrons, charged particles, photons
- More than 15,500 experiments (105,000 datasets)
- Nearly full coverage of neutron-induced reactions



Nuclear Databases for Reactor Applications

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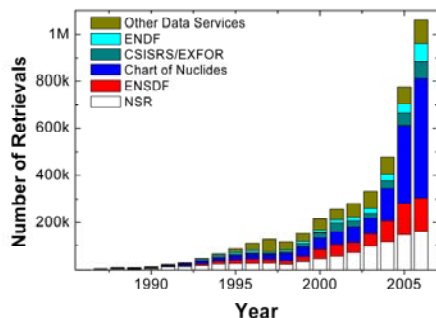
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NNDC Web Services

(www.nndc.bnl.gov)

NNDC is the leading provider of Internet Nuclear Reaction and Structure Data services over the past 20 years. Recent demand for these services shows remarkable growth, data retrievals exhibit increase by a factor of 3 in 2004-2006. In 2006, retrievals from the nuclear reaction database ENDF should increase by 135%.

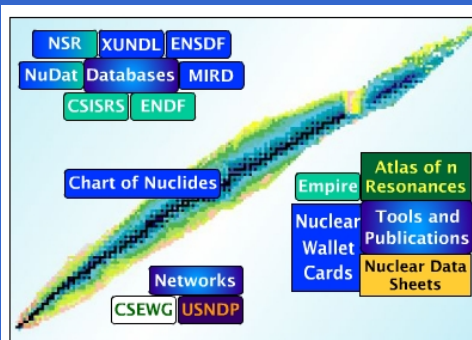


ENDF/B-VII Paper

An extensive paper on ENDF/B-VII.0 by Chadwick *et al.* (CSEWG collaboration) is under preparation for the December 2006 issue of Nuclear Data Sheets.



- Description of 14 sublibraries
- Neutron reactions (methodology, actinides, delayed neutrons & photons, fission products, high energy extensions, covariances)
- Thermal neutron scattering, standards, photonuclear, charged particles, decay data
- Validation (criticality testing, reaction rates, shielding & pulsed-sphere testing)



CSEWG&USNDP November 6-9, 2006 New ENDF/B-VII beta2

AMDC Atomic Mass Data Center, Q-value Calculator

CINDA Computer Index of Nuclear (reaction) Data

ENDF Evaluated Nuclear (reaction) Data File

NMSS & DoE NMIRD Safeguards & inventory decay data standards

Nuclear Wallet Cards for Homeland Security

Atlas of Neutron Resonances Parameters & thermal values

CSEWG Cross Section Evaluation Working Group

ENSDF Evaluated Nuclear Structure Data File

NSR Nuclear Science References

NuDat Nuclear structure & decay Data

CapGam Thermal Neutron Capture γ -rays [Updated]

CSISRS alias EXFOR Nuclear reaction experimental data

IRDF International Reactor Dosimetry File

Nuclear Data Sheets Nuclear structure & decay data journal

USNDP U.S. Nuclear Data Program

Chart of Nuclides Basic properties of atomic nuclei

Empire Nuclear reaction model code

MIRD Medical Internal Radiation Dose

Nuclear Wallet Cards Ground & isomeric states properties

XUNDL Experimental Un-evaluated Nuclear Data List

Links ordered alphabetically Order by category

Sponsored by the Office of Nuclear Physics - Office of Science - U.S. Department of Energy

Evaluated Nuclear Data File, ENDF/B-VII

(www.nndc.bnl.gov/endlf2)

Sublibrary	Materials	Sublibrary	Materials
neutron	393	decay	3630
thermal	20	d, t, He3	5, 3, 2
proton	48	standards	8
gamma	163	all others	same as V1.8

Library. The new library brings numerous improvements, extensions and excellent benchmarking results. Its release is defined by rigorous testing and validation procedures:

- ENDF/B-VII beta0 March 2005
- ENDF/B-VII beta1 October 2005
- ENDF/B-VII beta2 April 2006
- ENDF/B-VII beta3 September 2006
- ENDF/B-VII.0 December 2006

Paper. Dedicated paper should be published in December 2006, together with a paper on benchmarking.

Sigma Interface. New ENDF retrieval web interface is under development, its testing is expected in December 2006. New features:

- Transparent display and retrieval
- Easy navigation through libraries
- Flexible search and retrieval
- Mathematical operations on data

Nuclear Databases for Reactor Applications

New ENDF/B-VII Library by CSEWG



Contents

No.	NSUB	Sublibrary name	Short name	VII.0	VI.8
1	0	Photonuclear	g	163	-
2	3	Photo-atomic	photo	100	100
3	4	Radioactive decay	decay	3830	979
4	5	Spont. fis. yields	s/fpy	9	9
5	6	Atomic relaxation	ard	100	100
6	10	Neutron	n	393	328
7	11	Neutron fis. yields	n/fpy	31	31
8	12	Thermal scattering	tsl	20	15
9	19	Standards	std	8	8
10	113	Electro-atomic	e	100	100
11	10010	Proton	p	48	35
12	10020	Deuteron	d	5	2
13	10030	Triton	t	3	1
14	20030	³ He	he3	2	1
Full library				4812	1709

Highlights

- ❑ Revised actinides with improved performance in integral validation
- ❑ New and more precise standards
- ❑ Improved thermal neutron scattering
- ❑ Extensive set of 219 new fission product evaluations
- ❑ Many evaluations extended up to 150 MeV
- ❑ Post-fission beta-delayed photon spectra
- ❑ Photonuclear sublibrary
- ❑ New light nuclei evaluations
- ❑ Entirely new decay sublibrary
- ❑ New methods for covariances (13 new materials)
- ❑ Extensive validation

Verification (BNL)

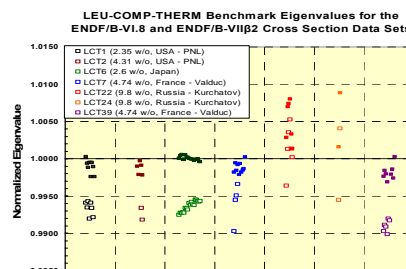
- ❑ Checking codes CHECKR, FIZCON, PSYCHE
- ❑ Processing code NJOY 99.125
- ❑ Transport code MCNP (simple run)

Validation (LANL, Petten, ANL, KAPL)

Extensive set of ICSBEP benchmarks (Petten):

	COMP				MET				SOL	Total
	ther	int	fast	mix	ther	int	fast	mix		
LEU	257				1				49	307
IEU	6	4				16			26	26
HEU		6			42	5	66	5	87	211
MIX	34		1			4			3	42
PU		1			1	7	6	105	120	120
²³³ U	8					4			5	17
Total	305	11	1	0	43	6	97	11	249	723

Example of C/E for k-eff (LANL):



U.S. Contributors

Sublibrary/activity	Major US contributors
Neutron sublibrary	LANL, BNL, ORNL
Thermal scattering sublibrary	LANL
Standards sublibrary	NIST, LANL
Photonuclear sublibrary	LANL
Decay data sublibrary	BNL
Proton sublibrary	LANL
d, t, ³ He sublibraries	LANL
Fission yield sublibraries	LANL
Atomic data sublibraries	LLNL
Data verification	BNL
Data validation	LANL, KAPL, ANL
Archival and dissemination	BNL

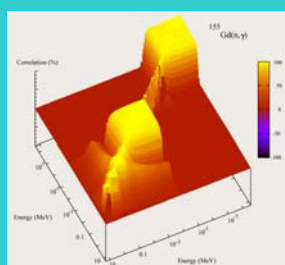
Release, December 2006

- ❑ Library ENDF/B-VII.0
- ❑ Special issue of Nuclear Data Sheets
- ❑ Sigma Web interface

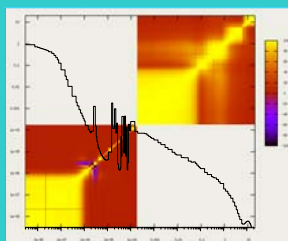
Covariances in ENDF/B-VII

New techniques for covariances (uncertainties and correlations) in the resonance and fast neutron ranges were developed.

3-D plot of uncertainty correlations in ¹⁵⁵Gd(n,γ)



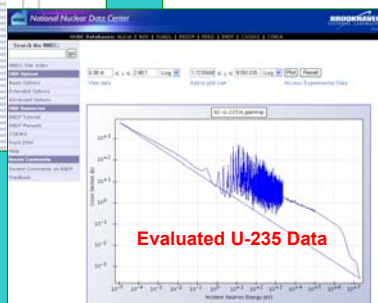
Energy-Energy Correlations in ¹⁵⁷Gd(n,γ)



SIGMA: New ENDF Web Interface

Objectives

- ❑ Easy navigation through ENDF libraries
- ❑ Transparent display of the data
- ❑ Flexible search and retrieval
- ❑ More extensive plotting capabilities
- ❑ Direct access to the plotted data
- ❑ Graphical comparison with EXFOR
- ❑ Mathematical operations on data sets



Status

- ❑ Database designed and built
- ❑ Basic retrievals implemented
- ❑ Simple plotting available
- ❑ Comparison with EXFOR
- ❑ Direct access to plotted data

Release expected in December 2006